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THE *Fuller* ROSE BEETLE

A PEST OF CITRUS

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Photo by R. A. Flock

This is a Fuller rose beetle, which not only attacks roses in the home garden, but avocados and berry vines. The photo shows the beetle enlarged about 15 times—adults are about one third of an inch long.

The chief commercial damage caused by this pest is in citrus groves, where it attacks both the foliage and roots of trees.

This bulletin describes studies made on the life history and habits of the Fuller rose beetle as they pertain to citrus orchards.

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To be brief . . .

The life history of the Fuller rose beetle was studied in tests conducted in southern California citrus orchards during 1940, 41 and 42. The purpose of the experiments was to determine the life cycle of the beetles under actual field conditions and to learn enough about their habits to bring about improved control methods.

While the beetles are known to attack many different weed and plant crops, they are especially troublesome in citrus groves and do the most injury to young trees. They eat off new growth as soon as it appears. Older citrus trees are not as susceptible to damage, but do suffer when infestations of the beetles are heavy.

Tests were made in specially prepared soil cages, set in citrus orchards, where the life cycle of the beetles was watched carefully. The tests were repeated for 3 years running.

Here is what was found

The Fuller rose beetle has one generation per year in southern California. The eggs are laid on the plants and the larvae enter the ground and feed on roots until the next summer. They then pupate and emerge from July through November, with the peak emergence in September.

Population densities as high as 65,000 beetles per acre were recorded in heavily infested citrus groves, and most of the beetles are apparently raised on citrus roots.

DDT gives control

For mature citrus trees the best control is probably use of a 5 per cent DDT dust, even though DDT sometimes encourages a build-up of other pests, particularly red spider mites. An 0.5 per cent lindane dust may also be used, and 50 per cent cryolite dust (standard practice among growers for many years) is still good.

For newly planted trees good protection is afforded by the use of DDT dust or of sticky tree-banding material. This material prevents the beetles from climbing the trunks to reach the leaves. The sticky material should be applied in a band at least 1½ inches wide.

Cotton bands proved ineffective in most cases.

A more complete description of the experiments carried on, and tabular material on the results obtained will be found starting on the next page.

And here are the details

The Fuller rose beetle, *Pantomorus godmani* (Crotch), is a gray-brown snout beetle about one-third of an inch long. The snout is rather short and square, and there are two whitish marks on either side of the body; a diagonal one near the center of the abdomen, and one on the posterior angle of the prothorax. It is probably South American in origin and has been carried to a great many parts of the world. It has been reported in Argentina, Brazil, Chile, Paraguay, Mexico, the United States, Canada, the Azores, Portugal, Spain, France, Italy, Sicily, Morocco, Transvaal, Australia, Easter Island, and Hawaii. In the United States it is found all over the country, but is ordinarily numerous outdoors only in the south Atlantic states and in California. It sometimes becomes very troublesome in greenhouses in the northern part of the country.

An excellent classification of this and other species of the genus *Pantomorus* has been published by Buchanan.* This species is referred to in the literature under the generic names *Pantomorus, Aramigus,* and *Asynonychus,* and under the species names *godmani* Crotch, *fulleri* Horn, and *olindae* Perkins.

As the common name indicates, this insect is rather well known as a pest of roses. It is particularly annoying to the amateur since it chews buds and flowers as well as leaves. It is, however, an insect of broad tastes and attacks a large number of weed and crop plants. The most serious injury in California is to citrus, particularly to young trees. Replants and interplants set in heavily infested areas are sometimes able to make very little growth the first summer. It is eaten off as soon as it appears. Older trees are less often injured seriously, although heavy infestations of this beetle result in severe chewing of the lower and inner leaves, and some loss of buds and fall growth. Avocados are often attacked, the injury being particularly serious to the new growth on topworked trees. Berry vines are a favorite food wherever this beetle is found.

Both the adults and the larvae injure plants by feeding on them. Both have chewing mouthparts. The adults, which cannot fly, crawl up plant stems and eat the leaves. This injury is easily recognized by the irregular edges of the eaten areas, as shown in the photo on page 5. The larvae live underground where they feed on roots, eating furrows from the bark of the roots as they move along them. Root injury is shown in the photo on page 6. It is recognized as serious in citrus nurseries and probably injures field trees almost as much, although this is seldom recognized.

The life cycle is fairly simple

No males of the Fuller rose beetle have ever been found, and Buchanan (1939) reports that Floyd Smith has proved that the females are parthenogenetic, that is, they produce fertile eggs without mating. The eggs are laid in the late summer or fall in crevices of the bark of trees, at the bases of plants, or on citrus trees, particularly under the buttons (calyxes) of the fruit.

The individual eggs are pale yellow, slender, and about one-sixteenth of an inch long. Eggs are laid in masses of 3 to 30 or more, and are covered by a white spongy material. Each beetle lays a number of egg masses at irregular intervals. The eggs hatch after about three weeks, and the newly emerged larvae fall or jump to the ground.

The legless larvae move about freely on the ground either by crawling after

* Buchanan, L. L. 1939. The species of Pantomorus of America north of Mexico. U.S.D.A. Misc. Publ. 341.

Citrus leaves injured by adult Fuller rose beetles. (From Bull. 214.)

the manner of the angleworm, or by jumping. In making a jump a larva draws the rear end of its body under itself and then straightens suddenly. In this way it propels itself through the air for a distance of one to three inches. The larvae do not try to dig their way into the ground, but enter the soil by falling down wide cracks or squirming their way down narrow ones. Once below the surface they force their way down until roots are reached.

In feeding, they move along the roots, eating out narrow strips of bark. This leaves furrows which show where the larvae have been. Larvae have been taken at depths of from three inches to more than two feet underground in citrus groves. They were found both under and between the trees.

When ready to pupate they stop feeding and move up through the soil, usually to within four inches of the surface, and form earthen cells in which they transform to pupae and later to adult beetles. The beetles remain in the cells until they are fairly well hardened and then force their way to the surface.

The flightless beetles are rather long-lived, feeding and laying eggs for several months unless eaten by birds or spiders.

Here is how the tests were conducted

Tests were made in soil cages to determine the length of the life cycle under field conditions in southern California. These tests were conducted near San Fernando in a mature orange grove. The soil cages were constructed of unglazed agricultural drain tile with bottoms of plaster of Paris. The soil was fumigated in the cages, plants started in them, rose beetle eggs introduced, and the whole covered with tight-fitting cages of copper screen. Of 12 cages used, 3 were planted with lemon cuttings, 3 with *Amaranthus* (amaranth, pigweed, careless weed), 3

with Bermuda grass (*Cynodon dactylon*), and 3 were left unplanted. One cage of each group was placed under an orange tree, one under the skirts of the tree and one between trees.

It was found impossible to maintain plants in the heavily shaded cages beneath the tree, so no results were obtained from them. The annual *Amaranthus* plants were replaced from time to time in an attempt to keep live roots present at all times. Beetle emergence was recorded.

The second year the experiment was repeated, except that *Malva* plants were substituted for the *Amaranthus* in the cages as food for the beetles.

And here is a report of results obtained

Beetles emerged only in those cages containing the growing lemon cuttings. Eggs introduced in October of 1940 gave rise to adult beetles in the late summer and fall of 1941, and eggs introduced in October of 1941 produced adult beetles in late 1942. Production was 3 and 5 beetles per cage in 1941, and 1 and 5 per cage in 1942. This shows that under orchard conditions in southern California there is one generation of Fuller rose beetle each year. Citrus roots obviously were satisfactory food, and Bermuda grass was not. It is impossible to be certain as to whether *Amaranthus* and *Malva* were satisfactory or not, since there was some difficulty in maintaining a constant supply of healthy roots in those cages. The results would appear to indicate that most of the beetles in a citrus grove are raised on citrus roots.

Emergence and populations.

Twelve emergence cages covering a total area of 27 square feet were placed in an orchard near San Fernando on July 11, 1940 and left there until November 30, 1942. During this period they were checked for emerged beetles 49 times. Records of beetle emergence are

Citrus root injured by Fuller rose beetle larvae.

Table 1. Emergence of Adult Fuller Rose Beetle from 27 Square Feet of an Orange Grove near San Fernando.

Month	Number beetles emerged 1940	1941	1942
January	..	0	0
February	..	0	0
March	..	0	0
April	..	0	0
May	..	0	0
June	..	0	0
July	2	2	2
August	17	5	5
September	20	9	27
October	1	3	4
November	0	1	3
December	0	2	..
Total, 27 square feet	40	22	41
Total, as per acre	64,533	35,493	66,147

shown in table 1 and indicate an emergence of approximately 64,000; 35,000 and 66,000 beetles per acre for the three seasons. An application of cryolite dust on August 23, 1940 probably accounts for the lower total emergence in 1941. In each of these three years emergence began about July first and peaked in September. It then continued at a reduced rate into the fall or early winter.

Beetles were caught in the cages between the trees at about the same rate as in the cages under the drip or near the trunks of the orange trees. One cage that was set in Bermuda grass sod caught only an average number of beetles. It appears that the concentrations of beetles sometimes seen on trees above grass are caused by the beetles climbing onto the trees by way of the grass stems. Sod also makes it more difficult to cultivate the soil so that pupation cells are not broken up and the orange roots approach the ground surface.

During the 1942 season, similar emergence cages were maintained around lemon trees in a grove near Fillmore. Emergence records, which indicated an emergence of 53,000 beetles per acre, were similar to those taken at San Fernando except that there was a heavier emergence in July. This Fillmore grove was interplanted with small orange trees. About 10 per cent of the beetles were found on the small interplanted trees. The other 90 per cent apparently attacked the large trees because the grove was kept free of weeds.

Since the beetles live for a considerable period after emergence the population of beetles in a grove remains high for some time after the peak of emergence has been reached, as is shown in table 2. Beetles found on plants during the late winter and spring months are undoubtedly survivors that have lived through from the fall or early winter.

Table 2. The Relative Number of Adult Fuller Rose Beetles Present in a Citrus Grove near Fillmore During Various Months in the Fall of 1942.

Month	Number beetles climbing 100 interplanted trees
July	20
August	192
September	628
October	627
November	358
December	105

These control methods can be recommended

For a great many years the standard control on mature trees was a 50 per cent cryolite dust applied in late August or early September. This often reduced the population considerably during the season it was applied and the next, by killing many beetles before the eggs were laid. Recently planted trees were protected by bands of sticky tree-banding material which prevent the flightless beetles from climbing the trunks to reach the leaves. Tests made in 1942 to compare various methods of protecting small interplanted orange trees showed that barriers of sticky tree-banding material* at least 1½ inches wide were the most effective means of preventing injury. A comparison of the number of beetles caught in the sticky bands with the number apparently stopped by them (since they did not reach the leaves) showed that only about 6 per cent of those stopped were actually caught by the sticky material. It was observed that beetles usually approached the sticky band cautiously, felt it with a front leg or antenna, moved along its edge and then after a period retreated to the ground. When a beetle did reach the sticky band with a rush it ordinarily continued upward for about an inch, then turned around and went back down and out of the sticky material.

Cotton bands, which have sometimes been recommended, proved ineffective except when black widow spiders took up residence beneath them. The spiders caught practically all the beetles that tried to pass.

Since the development of the newer synthetic organic insecticides, the Fuller rose beetle has ordinarily been controlled by either a 5 per cent DDT dust or a 0.5 per cent lindane dust. Of these two, the DDT dust is the more commonly used and is very effective in killing the beetles. Its action is considerably faster than that of cryolite so that it may be used to protect recently planted trees. Unfortunately the use of DDT on plants often leads to a build-up of other pests such as aphids, or particularly red spider mites. Where it seems desirable to avoid the built-up of these other pests the older treatments, such as cryolite dust, are still doing a good job.

* The material used was "Deadline," manufactured by the California Spray-Chemical Corporation.

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